PLANT PROTECTION BULLETIN

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CONTENTS

Entomological problems of agriculture in the Anglo-Egyptian Sudan, by R. J. V. Joyce 1

Plant disease situation in the United States, by Paul R. Miller 7

Some diseases of economic plants in Bihar, India - II, by M. J. Thirumalachar and J. N. Mishra 11

Outbreaks and new records 13
Israel

News and notes 16

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FAO PLANT PROTECTION BULLETIN

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FAO Plant Protection Bulletin

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World Reporting Service on Plant Diseases and Pests

Entomological Problems of Agriculture in the Anglo-Egyptian Sudan

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Agriculturally the Sudan can be divided conveniently into two regions separated by the 500 mm. isohyet which roughly follows the railway line between Kassala and El Obeid. North of this line crop production largely depends on irrigation from the Nile and south of it on rainfall. The cotton of the northern region is by far the most important, and the main cash crop of the Sudan as a whole. The bulk of this is grown in the Gezira whose sakellarides (*Gossypium barbadense*) is firmly established in the world cotton market. In the north also a limited amount of durra (*Sorghum vulgare*) is grown under rainfall, usually in wadis and depressions; lubia (*Dolichos lablab*) and chick peas (*Cicer arietinum*) are sown in basins watered by the Nile; dukhn (*Pennisetum typhoideum*), maize, wheat, haricot beans and barley are grown in the wake of the receding flood; pump schemes and sagiyas (water wheels) produce dates, mangoes, citrus, guava, bananas and vegetables. The bulk of the durra and dukhn, which are the staple grain foods of the indigenous population, is grown under rainfall in the region south of the 500 mm. isohyet. In higher rainfall areas of the southern region American upland cotton (*Gossypium hirsutum*) is grown extensively. Other important arable crops include sesame (*Sesamum orientale*), groundnuts and melons. Further south in Equatoria Province numerous crops, of which the most important are eleusine, groundnuts, beans, gourds, sesame and cotton, are grown by the peasants during the long rainy season.

Organization of Entomological Services

Investigation of entomological problems important to Sudan agriculture is the primary duty of the Government Entomologist and his staff, who form a section of the Research Division of the Ministry of Agriculture. The main research stations of the Sudan are the Gezira Research Farm, Yambio Experimental Farm (Equatoria) and the Central Rainlands Research Station, where entomologists work as a team with other agricultural specialists and make their own specific contribution to the establishment of a sound agricultural practice. As these research stations are inadequate to deal with immediate investigation of local problems, entomological field laboratories are established in several other places in the country. These stations define the problems and evaluate their importance, and subsequently the Government Entomologist may allocate resources to find a solution.

A second duty of the Government Entomologist is to initiate legislation designed to prevent the introduction into and the spread of new pests within the Sudan and to organize a Plant Quarantine Service to enforce this

legislation. Plant quarantine stations are established at Wadi Halfa, Port Sudan and Khartoum and are administered by an Inspector with headquarters in Khartoum.

A third duty of the Government Entomologist is the control of pests of national or provincial importance. There are pests which breed, or can most easily be controlled, in areas in which no individual can be responsible for their destruction. Locusts are the most important, but several others such as cotton stainer bugs, durra andat bugs, mealy bugs and pink bollworm are conveniently placed in this category.

The following paragraphs will deal with the present major research, plant quarantine and control projects which are at present in hand. The emphasis of the work is on cotton, which holds such an important place in the economy of the country.

Major Research Projects

Application of Insecticides

Control of the cotton jassid (*Empoasca lybica* Berg.) is now an established agricultural practice in the large cotton estates in the Gezira, and annually some 250,000 acres of cotton are sprayed with DDT. The distribution of one pound of technical DDT per acre by the most economical means is a problem of considerable importance. When spraying first began in 1945 DDT was distributed in 100 gal. water per acre applied by a sprayer with droplegs. The standard rate of application has now been reduced to 30 gal. per acre by land machine and 3 gal. per acre by fixed and rotary wing aircraft. Recent work has shown that considerable improvements can be expected. Application of an undiluted 25 percent DDT concentrate in oil at $^3/_4$ gal. per acre by fixed wing aircraft over a swathe width of 20 meters has resulted in economic control of the jassid. Experiments with drift spraying by an air blast machine have demonstrated the control of jassid, thrips (*Hercothrips fumipennis* Bagn. & Cam.) and flea beetle (*Podagrica puncticollis* Wse.) over a swathe width of 80 meters. The experiments, which have been carried out in close co-operation with commercial firms, have revolutionized ideas on crop spraying and work is in hand (i) to develop a land machine capable of distributing a 25 percent DDT concentrate at $^2/_5$ gal. per acre, and (ii) to apply drift technique to aerial spraying to increase the swathe width while still using the 25 percent DDT concentrate. Considerable importance is attached to these experiments since it is felt that it is in the development of such methods that the benefits of pest control by insecticides can be best brought to the extensive, but scattered, peasant cultivations of the rainlands, where spraying at the minimum cost, with the minimum quantity of water and the minimum ground organization is essential.

Cotton Pests in the Gezira

Control of the cotton jassid has substantially increased the wealth of the country and there is now scarcely any cotton in the northern Sudan which is not sprayed. Spraying, however, has brought with it many problems; the one which exercises most the attention of entomologists at the moment is that of cotton whitefly (*Bemisia gossypiperda* Misra & Lamba). While the incidence of whitefly is largely controlled by the meteorological conditions during the season and not by those of previous seasons, it is undoubtedly true that one effect of spraying with DDT has been to increase whitefly numbers when weather conditions favour the fly. But there is no evidence that spraying alone can cause whitefly to be a serious pest, if weather conditions are unfavorable. The cause of this increase in fly numbers after spraying is under investigation and data so far collected suggest that it is not attributable to destruction of the known hymenopterous parasites, *Encarsia* spp., *Eretmocerus diversiciliatus* Silv. and *Prospaltella* sp., which do not appear to exert any important influence on whitefly numbers in the Gezira. On the other hand it seems more likely that DDT, either directly or by destroying jassids, alters the cotton leaf in such a way as to make it more favorable for whitefly feeding. The effect of DDT on leaf size and composition is therefore being studied.

The economic importance of whitefly feeding on plant tissue has been established

over the past three years. In large scale field trials, control of whitefly achieved by the application of parathion at ¼ lb. per acre has given important increases in yield. The most striking feature revealed by plant analysis in these trials was the loss of fruiting branches which dried up and were shed as a result of severe whitefly attack. Such shedding was negligible in plants sprayed twice and thrice with parathion, as the treated crop retained over 20 percent more of its fruiting points than in the unsprayed ones. In the absence of whitefly, the weight of seed cotton per boll was 13 percent greater due to increases in both seed and lint weights, and fiber lengths also showed an increase.

A further effect of DDT spraying is the apparent delayed fruiting, the increases in yield being made up to a large extent from bolls formed late in the season. This is important since the first formed bolls give the highest grade of cotton. Preliminary data from investigations in progress suggest that it is not the DDT which delays fruiting but the presence of jassids which advances it.

The effect of DDT on bollworm populations has been followed with the keenest attention. There have been indications that slight increases in numbers of *Earias insulana* Boisd. and *Heliothis armigera* Hubn. have resulted from spraying, causing increased shedding of buds. Since the shedding associated with bollworms has not been greater than the normal physiological shedding, which in the Gezira is about 30 percent, no yield loss from this effect of DDT has been demonstrated. Nevertheless investigations are continuing to establish how much of the early crop is affected.

These problems have resulted from the application of DDT spray, which, inasmuch as yields have been improved, may be regarded as an improved agricultural technique. Similarly other advances in agricultural practice have brought their own pest problems. The development, for example, of blackarm resistant strains of cotton has enabled sowing dates to be advanced, but has also resulted in increased severity of attack by the flea beetle, *Podagrica puncticollis*. By advancing flowering, *Heliothis armigera* has become more prominent in destroying the first formed buds and thus delaying the crop. These problems are also receiving the attention of the entomologists.

Cotton Pests in Areas of Flood Irrigation

The Gash Delta, an inland delta in the eastern Sudan, and Tokar Delta on the Red Sea coast are important cotton growing areas where bollworms constitute the main pest problem of cotton. In the Gash Delta *Diparopsis perditor* Clem. may destroy up to 25 percent of the mature bolls. Indirect losses by destruction of the fruiting potential are more difficult to determine, but any increases in yield which may be expected and which have been demonstrated through the control of leaf-feeding insects are masked by losses due to this bollworm. Intensive study of the biology of the bollworm with particular reference to the incidence of long and short cycle pupae and larval wandering habits, has been in progress for the past two years. A very wide range of insecticides has been tried, but the limited success achieved does not encourage the belief that control of *D. perditor* lies in the use of chemicals. A more hopeful line of approach appears to be in cultural operations. Slight changes in the existing agricultural practice to enable the land which carried cotton in one season to be disced and flooded in the next shows promise. When this objective has been achieved it is likely that the control of other pests can be profitably undertaken.

In Tokar Delta, on the other hand, the serious loss of fruiting points from *H. armigera* and the bug *Creontiades pallidus* Ramb. has been the object of study for some four years. Although premature shedding of fruiting points may reach 75 percent in a plant, it has not been possible to establish that reduction of shedding associated with insect damage in fact reduces the total shedding. On the contrary, as shedding associated with insect attack decreases, the shedding from apparently physiological causes increases. The problem is still under investigation because, although insect control may not contribute to increased yields, it may be possible to advance the picking date and so improve the grade.

Cotton Pests in Rainfed Areas

The most important pests of rainfed cotton in the Sudan are the pink bollworm (*Platyedra gossypiella* Saund.), *Diparopsis perditor*, and stainer bugs (*Dysdercus* spp.). *P. gossypiella* is kept under control here, as in the rest of the Sudan, by an enforced dead season for cotton and other host plants. The control of *Diparopsis* and *Dysdercus* is the subject of investigation. Work during the past season has shown that the nymphs of *Dysdercus* emerging from eggs laid in soil contaminated with certain soil insecticides are killed either before or soon after emergence. There are also indications that adults in contact with sublethal doses of insecticides in the soil do not copulate and lay eggs normally, and are rendered more or less infertile. The application of this promising line of investigation is now being studied. Control of *Diparopsis* in an area where mechanical cultivation, flooding or normal spraying procedures are out of the question presents an intractable problem, but a new line of approach is being planned.

Sorghum Pests in the Central Rainlands

Durra (sorghum) is a crop indigenous to the Sudan and, in the central rainlands the midge, *Contarinia sorghicola* Coq., is the only important pest which breeds in the crop. The common stem borers, *Sesamia cretica* Lederer and *Atherigona* spp., inflict some losses on seedlings, occasioning resowing, but do not seriously damage the mature crop. Other important pests of durra breed outside the crop but invade the ripening crop in such numbers and with such suddenness that control by conventional insecticidal methods is of little avail. The most important of these pests are locusts (*Locusta migratoria migratoriodes* Rch. & Frm.), grasshoppers, of which *Aiolopus savignyi* Kr. and *Catantops axillaris* Thunb. are the most important of the 40 odd species recorded attacking the crop, the durra andat (*Agonoscelis versicolor* F.) and the weaver bird (*Quelea quelea aethiopica*).

The Sudan has not been invaded by *Locusta* since the inception of the *Comité Provisoire pour la prévention Acridienne dans le Soudan*, which keeps under supervision the outbreak area in the Niger inundation region. The ecology of grasshoppers has been studied and the main breeding areas defined. Control in these breeding areas should be possible but awaits the appointment of staff. The durra andat is controlled with BHC dusts in its aestivating sites on trees during the dry season. Potentially the weaver birds are the most serious pests whose destruction has been effected until recently by blasting with gelignite in their dry season roosts. Recent observations on the migration of these birds have cast doubt on the efficacy of this method in preventing crop damage and have indicated that to ensure crop protection birds must be killed in their nesting sites. Since nesting occurs during the rains, when sites are largely unapproachable by land, plans are being developed for the organization of aerial reconnaissance and for the destruction of birds and nests by aerial means.

Pests of Fruit Trees

Fruit occupies an important place in the economy of the country only in the Northern Province of the Sudan, and happily orchards have remained remarkably free from serious pests. Until recent years only the mealy bugs, *Phenococcus hirsutus* Green and *Ferrisia virgata* Ckll., have caused concern, and indeed, in spite of trials with a great many modern insecticides a satisfactory method of control has yet to be found. In 1949 however, serious damage to oranges, grapefruit and mango was caused by the fruit fly, *Pardalaspis quinarii* Bezzi. This fruit fly was first recorded in the Sudan in 1934 on guava and has since been annually a serious pest of this crop. Its other known localities are Transvaal, Rhodesia and South–West Africa where it has been recorded on fig, apricot and peach but not in serious numbers. It has never previously attacked any citrus. Since 1949 *P. quinarii* has occurred annually as a pest of citrus in an increasing number of localities in Northern Province, and provides an interesting example of the change of habit of an insect. It has not been possible to carry out detailed investigations of the habits and life–history of the fly, but consid-

erable protection of citrus has been achieved by destroying infested guava fruit and by bait spraying of guava and citrus with sodium fluosilicate in sugar solution. BHC has so far proved less effective on account of its volatility in the high prevailing temperatures.

Locust Research

Some of the earliest research on the Desert Locust was carried out in the Sudan where the change from the solitary to the swarming phase was first observed in the field in 1926. An entomologist is now working on locust research on the same lines as the East African Desert Locust Survey.

Developments in Grain Storage

Grain in the major producing areas is infested in the field, the most important primary pests being *Sitotroga cerealella* Oliv., *Calendra oryzae* L., and *Rhizopertha dominica* F. In the central rainlands, although water content of durra at harvest is only 9 to 10 percent or even less, the infestation is able to survive until the following rains when with rising air humidity rapid development takes place. Large scale trials have been in progress during the last three seasons to study storage in underground pits – a system used by the natives. Since the soil in the area is heavy clay, which is seldom penetrated by rain to a greater depth than one meter, and there is no water table, no special construction for pits was necessary. It has been found that, with at least one meter depth of soil covering the grain, storage for two rainy seasons could be achieved with insignificant losses. Observations have indicated that the infestation is destroyed by heat sterilisation.

In the humid south, on the other hand, it has been found necessary to dry the durra. Trials have been carried out with a vertical drier and a platform drier, both oil heated. The most striking results from these investigations were, firstly, the extremely severe losses experienced from insect attack, averaging 30–40 percent during one year's storage, secondly that the rate of drying by both machines was more rapid than under temperate conditions, and thirdly that a high degree of disinfestation could be achieved by both machines, but especially by the former. Experiments in various methods of storage are in progress.

Progress in Pest Control

The two most important campaigns against pests are jassid spraying and locust control. The former is carried out under contract arrangements and the latter is organized by the Government Entomologist.

The last severe locust invasion of the Sudan was in 1950 when over 2,000 tons of poison bait were expended in a successful campaign. The activities of the East African Desert Locust Control in Arabia and poor early rains in 1951 and 1952 have together been responsible for freedom from swarm breeding in the Sudan since that time. During the present season, however, a serious invasion is expected from the west.

Locust campaigns are costly and the heaviest expenditure in control is incurred in locating the hoppers and in the transportation of the poison. Thus in 1950 nearly 700 scouts and 200 vehicles were employed to discover hoppers and to distribute some 1¼ tons of the active ingredient of insecticide. It was clear that considerable economy could be achieved if methods of detecting locusts could be improved, and the insecticide applied in a more concentrated form. The development by the East African Desert Locust Survey of methods of aerial spotting and destruction of flying locust swarms was therefore followed with intense interest, and a proposal that during 1953 the airspray unit of the Desert Locust Survey should operate in the Sudan was accepted with enthusiasm.

At the present time this airspray unit, supplemented by a Sudan flight of hired Auster aircraft all under the operational control of the officer in charge of the airspray unit, is in readiness for a locust invasion. The object is to intercept invading swarms as they cross the Nile, and to destroy or disperse them in flight by DNOC spray. Should destruction be incomplete contact will be maintained with the swarm, which will be continuously harassed until egg lay-

ing is complete. The marked egg-fields will provide an easy target for ground baiting teams. To achieve these objects a number of landing strips have been opened and provided with supplies of insecticide, petroleum, oil, lubricants and water ready for immediate operational use. Sites have been selected to give greatest defence in depth.

The operation is in the nature of an experiment. It is known that low flying swarms can be detected from considerable distances and can be destroyed in flight. It is not known what proportion of the swarms which invade the Sudan fly high or by night, thereby evading the first line of defence. Only aerial operations of the type envisaged can provide the answer to these questions.

TITLES SELECTED

No. 1.

The desert locust situation
Potato blight in Chile
Progress in plant protection in India

No. 2.

The locust problem in Central America and Mexico
Pineapple diseases and pests in Mexico
Insect problems in Nicaragua

No. 3.

The migratory locust in South America
Plant disease situation in the United States
Two important tree borers in Israel

No. 4.

Disease outbreaks on economic plants in Italy
Major pests of crops in Afghanistan
Wheat rusts in Spain in 1952

No. 5.

International Plant Protection Convention: its history, objectives and present status
Plant disease situation in the United States
Virus diseases of cereals in Canada

No. 6.

Plant disease situation in the United States
A foliar disease of legumes in Central America
International Wheat Rust Conference

No. 7.

Plant pathology in Colombia
Control of olive fly in Israel

No. 8.

Plant disease situation in the United States
Apple leaf-curling midge, a new pest in New Zealand
Turnip mosaic of swedes in Eastern Canada

No. 9.

Observations on the Mediterranean fruit fly on citrus in Tripolitania in 1952-53
Plant disease problems in Central America

No. 10.

Some diseases of economic plants in Bihar, India
Aster yellows on various hosts in the United States
Insects and diseases affecting some crops in El Salvador

No. 11.

Insect pests in British Colonial Dependencies; a half yearly report
Pests of edible legumes in Chile
A new white grub on apple in Israel

No. 12.

Plant diseases in British Colonial Dependencies; a half yearly report
A survey of the newer insecticides
Lowland rice culture as an economic control of Sclerotinia and root-knot nematodes

The sections "Outbreaks and New Records" and "Plant Quarantine Announcements" which appear in each issue contain information on the incidence and spread of destructive plant pests and diseases, and most recent plant quarantine regulations, covering wide geographic range.

FROM PREVIOUS ISSUES

Plant Disease Situation in the United States

32 p682

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Clitocybe Root Rot, an Important Disease in Georgia Peach Orchards

IT is generally recognized that peach trees replanted on old peach orchard sites are shorter-lived than the original trees. This problem has existed for a number of years, and during the late thirties growers began requesting information relative to its cause and solution.

In 1946, after preliminary survey work, field studies were started at the Georgia Agricultural Experiment Station. One of the sites selected for experimental study had been under peaches continuously since 1929. By the end of 1948, trees replanted on this site were dying from causes that were not immediately determinable. During the spring of 1950 large numbers of trees were below normal in appearance. Excavation of affected trees showed that at depths ranging from 8 to 14 inches below the soil surface, the bark of the roots was dead. The mycelium of a fungus was found on the roots. At about the same time the same fungus was discovered on trees planted in 1945 at the U. S. Horticultural Field Laboratory, Fort Valley, Georgia. The only apparent cause for the death of the trees was the girdling of the crown and root system well below the ground line, and the presence of a white mycelium in the affected areas. Before 1952 no fruiting bodies were detected in the field, and laboratory attempts at identification of the fungus were unsuccessful. During the second and third weeks of September 1952, heavier than normal rainfall was especially favorable for the development of the fungus, and sporophores found in the Georgia Experiment Station orchard were identified as *Clitocybe tabescens* (Fr.) Bres.

The experimental plot at the Georgia Experiment Station included not only peach trees replanted in 1946 but also 98 trees planted originally in 1929. From 1929 to 1946, 95 percent of the original trees grown on this site were living after seventeen years. By September 1952, however, 53 of the 98 original trees remaining there had died. Of these dead trees, about 50 percent were killed by the attack of *Clitocybe tabescens* and it would appear that many more also died of the same cause although it was not then recognized. In this block of trees, five clusters of sporophores were found in September 1952 and sporophores were also produced on tree trunks placed in a moist chamber. The high death rate of the original trees during the six years following the experimental planting is in marked contrast to the previous low mortality.

Clitocybe tabescens apparently has occurred in Georgia peach orchards for many years and probably has contributed considerably to the loss of trees. There are several reasons for failure to recognize the presence and wide distribution of *C. tabescens*. The common cultural practices of cultivating the soil towards the tree rows, hoeing grass and weeds from the bases of the trees, and mounding the trees in the fall for the borer treatment were unfavorable for its fruiting. The dry weather usually prevailing in September and October prevented to a large extent the formation of fruiting bodies of the fungus. Furthermore, any injury observed on the peach tree crown was usually ascribed to the chemicals used in borer control or to winter injury.

After identification of the disease in two widely separated areas, Experiment and Fort Valley, a preliminary survey was made of orchards in the principal peach growing sections of Georgia. Many of the orchards in the Fort Valley area have been planted with peach trees continuously for 30 to 50 years. Six large orchards inspected in this preliminary survey were found to be infected with *Clitocybe tabescens*. Further survey revealed infected trees in 16 of 18 additional orchards. In some of the orchards in which young replants were dying or dead,

C. tabescens was identified on the old roots left in the soil from the preceding tree. It is apparent that after the disease becomes established in an orchard, a gradual build–up of the inoculum takes place. This explains why some two–year–old trees were observed to be succumbing to the attacks of the fungus in the Fort Valley area. In one case, of 79 eight–year–old Elberta trees pulled recently, 30 were affected with Clitocybe root rot.

In one orchard in the Middle Georgia peach section in which the grov er had reported trouble as early as 1938 in peach replants, a total of 22 dead trees showed the root crown and lateral roots to be infected with *Clitocybe tabescens*. On 14 of the 22 dead trees the dried–up remains of old sporophores of the fungus were discovered at the base. On another tree a fresh cluster of sporophores was noted. Three additional trees still living were also attacked by the fungus. This orchard had been in peaches continuously for 35 years.

Clitocybe root rot was found in several other old orchards or orchards which had been replanted in the Middle Georgia peach section. The disease was also present on trees in one orchard on newly cleared land, but it was not found in new orchards established on old cotton lands in the same general area.

Root rot caused by *Clitocybe tabescens* was found to be widespread and destructive in peach orchards examined in both the Piedmont and Sandhill peach sections of South Carolina.

The fungus is commonly found in the southeastern United States on many different hosts. Its presence on peach trees was recognized in Oklahoma before 1901 and in Arkansas, Missouri, and Florida as early as 1902. It was reported as occurring on apple trees in Georgia in 1920.

The survey shows that Clitocybe root rot is of general occurrence in peach orchards throughout both the major and minor peach growing sections of Georgia and that it occurs in orchards in both the Piedmont and Sandhill peach sections of South Carolina. In Georgia Clitocybe root rot of peach trees is found mainly on land planted to peaches for periods ranging from 30 to 50 years. The usual history of such orchard sites is a long period of cotton growing previous to the setting of the peach orchard. As would be expected, Clitocybe root rot was found in the one orchard that was established on recently cleared land. Trees budded on Yunnan, Shalil, and Tennessee Natural rootstocks were found to be infected and these rootstocks are evidently not resistant. With the gradual build–up of inoculum, peach trees die at progressively earlier ages when they are replanted on old orchard sites.

The prevalence and wide distribution of Clitocybe root rot at least partially explain why peaches will not follow peaches successfully under Georgia conditions. Old peach orchard sites should not be replanted with peaches. It also appears that peaches should not be planted on newly cleared forest land, since there seems to be a relationship between the incidence of this disease and timbered lands.

Stem Nematode Disease of Greenhouse Hydrangeas

In the spring of 1949, and to a lesser extent in 1951 and 1952, an unusual abnormality was found on greenhouse hydrangeas, *Hydrangea opuloides* Koch (= *H. macrophylla* (Thunb.) DC.), in Alabama. This disease was previously briefly reported only twice, in both cases from Europe.

As found in March 1949, the disease was characterized by tip necrosis, scattered necrotic spots, and prominent stem hypertrophy (Figure 1, A & B). In late April 1949, a few more plants were found with a less severe expression of the disease. Since the symptoms were similar to stem nematode disease of phlox, the diseased tissues were examined for nematodes. Active individuals of the genus *Ditylenchus* were found.

Only one other probable observation of a *Ditylenchus* sp. on hydrangeas in the United States is known, on plants growing next to nematode–infected phlox in Salem, Oregon, in 1932. Diseased hydrangeas in Alabama had never been near infected phlox. Careful investigation showed that the 1949 condition developed while the plants were being "forced" in the retailer's greenhouse. No evidence of the disease was found in plants of wholesale origin.

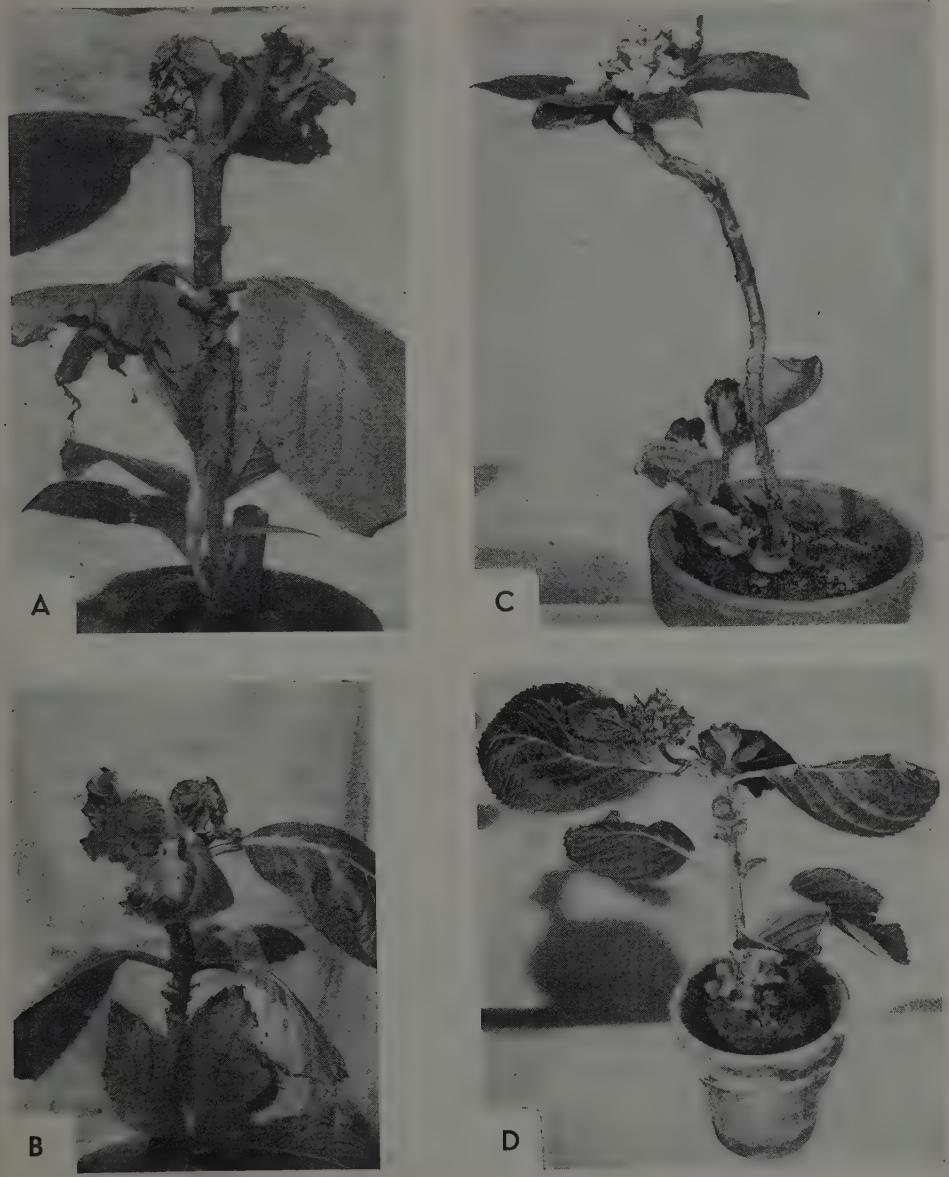

Figure 1. *Stem nematode* (Ditylenchus sp.) *disease of greenhouse hydrangeas. A & B, severe infection; C & D, moderate infection.*

A. *Fusiform gall, bud necrosis, and leaf-blade necrosis.*
B. *Closeup of bud and leaf-blade necrosis.*
C. *Stem elongation without hypertrophy, moderate stem necrosis, and leaf abscission.*
D. *Elongation of floral stalk, virescence of flowers, and proliferation of lateral buds.*

There is almost no indication that nematodes affect older stem tissues. One prominent canker was found at about one inch from the soil (Figure 1, C) but it could have been due to any of a number of agents. Prolific development of normal branches from lateral buds (Figure 1, C & D), particularly the basal ones, suggests that lateral buds are not prominently infected by the nematodes. Observations indicate that the invasion of the terminal bud occurs early in its development, and is followed by a period of hibernation and incubation of the nematodes. The nematodes apparently become active again during the "forced" growth of the hydrangeas after lateral buds have formed and become dormant because of terminal bud dominance. All of the reactions noted suggest centralization of the nematode's activity in succulent, non–dormant terminal meristematic tissue and stem parenchyma.

Two main types of reactions have been observed: (1) moderate infection involving stem elongation without hypertrophy (Figure 1, C & D), and (2) severe infection involving stem hypertrophy without elongation (Figure 1, A & B). Both types are accompanied by some necrosis and there are always indications that this disease develops partially as a result of practices associated with forcing.

In severe infection the most striking symptoms are necrosis of the terminal bud (Figure 1, A & B) and hypertrophy of new stem growth (Figure 1, A). In the cases observed, the terminal bud was completely destroyed, leaving a blackened, indented stub at the stem tip (Figure 1, B). Enlargement in the slightly tapering fusiform galls was from one–fourth to one–half diameter.

Infected stem tissue is excessively succulent, but severely infected plants appear to be highly susceptible to wilting. Some such infected plants could not be induced to recover from artificially induced wilting, while others recovered quite readily.

The epidermis of the hypertrophied stems changes from faintly chlorotic to distinctly yellowish, and a streaked necrosis develops with prominent brown borders and yellow to white interiors. Eventually extensive and irregular blackened necrotic areas are formed.

Petioles of older leaves also develop this bordered streak necrosis, but without hypertrophy. Large necrotic areas also are found on leaf blades of severely infected plants. Necrosis develops primarily from tips of the leaves and inward from margins. Irregular spots, either black from the beginning (Figure 1, A) or bleached yellowish then black ening, are the eventual results. Undoubtedly high temperatures and humidity during the forcing period are factors favoring the development of the necrosis.

In moderate infection there is no detectable hypertrophy, but rather an appreciable elongation of either the entire new stem growth (Figure 1, C) or of only the floral axis (Figure 1, D). Considerable leaf abscission (Figure 1, C) accompanies moderate infection, but there is little leaf–blade necrosis. Bordered streak necrosis develops on new stems and petioles (Figure 1, C), but rarely does it become blackened. There is pronounced stimulation of lateral bud development (Figure 1, D) even though apical dominance is not counteracted by death of the terminal bud.

Elongation from the terminal meristem is noticeably stimulated and apparently all meristematic tissue remains alive. Floral buds develop, but the resultant flowers are abnormal, small, and few in number (Figure 1, C). Petals are misshapen, and usually white, but sometimes much chlorophyll develops in petals (Figure 1, D).

Two years' experience with this disease indicates that control is obtained best through destruction of infected plants, soil sterilization, and other sanitation measures. Infected plants have been kept for two years under conditions of excellent sanitation. These plants have neither recovered nor died, remaining alive but completely worthless.

Some Diseases of Economic Plants in Bihar, India-II

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THESE notes, a continuation of the previous article, (See Vol. 1, No. 10, pp. 145–146), cover some noteworthy or previously unrecorded diseases of economic plants in the State of Bihar. The observations were made during the year ending March 1953.

Sclerotium Wilt of Eggplant

A severe wilt disease affecting eggplants (*Solanum melongena*) in fields near Harnath Bihar, was found to be due to the killing of roots and girdling of the collar by *Pellicularia rolfsii* (Curzi) West (= *Sclerotium rolfsii* Curzi). The fungus produced branching strands of hyphae bearing numerous sclerotia about the size of mustard seeds. The infected plants at first showed yellowing of the lower leaves and then gradual wilting of the entire shoots. The disease also caused wilting of potato and tomato plants in restricted areas, but eggplants appeared to suffer most seriously.

Eggplant seedlings wilted readily when grown in soil inoculated with vigorously growing cultures of *P. rolfsii*. Exposure of the rapidly growing colonies of the fungus in the laboratory to traces of paradichlorobenzene (PDB) vapour appreciably retarded the growth. When freshly seeded cultures of the fungus were exposed under glass cylinders to an atmosphere containing 1 : 10,000 parts of PDB, the mycelium failed to develop normally, producing only very small patches of growth even after prolonged incubation. Sclerotial formation was completely arrested.

Effects of PDB in soil application were tested in fields at Harnath where severe infection of eggplants had occurred. Plants were removed from the field as they wilted, and the apparently healthy plants used for replanting were treated with PDB at the rate of ½ ounce for five plants. Because of the cool weather the PDB crystals, which were dispersed around the base of the plants 4 to 6 inches deep, did not volatilize readily. No injurious effects were noticed on eggplants and this soil treatment with PDB appeared to reduce the wilting of plants by at least 60 percent as compared with the non-treated plots. Further studies on the economy of this method are being made. Previously PDB has been used successfully as an eradicant in controlling blue mold in tobacco seed beds in the United States and other countries.

Myrothecium Leaf Spot

Myrothecium roridum Tode ex Fr. was found to produce leaf spotting of tomato, okra (*Hibiscus esculentus*) and green mung bean (*Phaseolus radiatus*). The leaf spots produced were circular, 5 to 15 mm. in diameter, and greyish-white in appearance due to thin strands of hyphae growing over the dead leaf surface. In later stages the sporodochium of the fungus developed in the center of the spot with green masses of spores.

The fungus is very common in Bihar, fruiting profusely on decaying stalks of sunn hemp after they are ploughed under as green manure. The fruiting bodies occur in discoid pinhead-like crusts, greenish at first and later turning olive black. They can be seen abundantly after rains during July and August.

Myrothecium roridum has previously been recorded by Stevens and McColloch[1] on

[1] STEVENS, J. A. and L. P. MCCOLLOCH. Myrothecium as a fruit rot organism. Plant Dis. Reptr. 31 : 147–149, 1947.

tomato causing fruit spot and also on many other plants. In India, it was reported occurring on cowpea leaves.

Alternaria Fruit Spot of Tomato

Tomatoes are planted in Bihar from September onwards and harvested up to the end of May. In the crop planted or harvested late, fruits were often found to bear circular cankered spots, 2 to 3 mm. wide, often enlarging up to 1 cm. The spots were hard and sunken, greyish–black at first and turning greenish–black after the causal fungus had produced conidial masses. Examination and cultural study proved the fungus to be *Alternaria*, identical with *A. tenuis*. The fungus was found to be a weak parasite, attacking the fruit mostly at the stem end or along growth cracks which occur more often on the exposed side of the fruit.

Alternaria solani (E. and M.) Jones and Grout and *A. tomato* (Cke.) Weber were previously known to produce spotting on tomato fruits. Both species are readily distinguishable by spore characters. While *A. tenuis* is known generally as a saprophyte, its occurrence on tomato fruits causing cankers is of interest.

Watery Rot of Tomato

Large stocks of tomato fruits harvested in May developed a watery rot, resulting in considerable losses. The already over–ripe fruits collapsed into a mush, with sour smelling fluid oozing out. The rotting was at first attributed to severe summer conditions and the poor keeping quality of the variety concerned. Examination of partially decayed fruits, however, showed that the rot began as a small soft water–soaked patch which rapidly expanded to involve the entire fruit. The causal organism was identified as *Oospora lactis–parasitica* Pritchard & Porte, which was reported to produce a similar disease in the United States. On the decaying fruits, the fungus produces a white powdery mass of conidia developed in chains. Prompt removal of diseased fruits and sanitation in handling and storing of fruits may help in reducing losses.

Rhizoctonia Blight of Peanuts and Mung Beans

Large patches of plants of peanut (*Arachis hypogaea*) and green mung bean were killed in the field by a fungus producing web–blight symptoms. The disease appeared sporadically at first but gradually a large number of plants became affected. The infected plants were covered by strands of hyphae which killed the leaves, girdled and killed the shoots and finally caused the wilting of the plant. On peanuts, the fungus penetrated into the gynophores and prevented pod formation. The fungus was identified as a species of *Rhizoctonia* bearing numerous yellowish–brown sclerotia which were sphaeroid but slightly irregular. The hyphae were closely septate and several of them produced basidia with basidiospores. In artificial culture the basidiospores gave rise to hyphae bearing sclerotia.

As regard the type of symptoms produced, the fungus resembles *Corticium microsclerotia* Weber which is considered now to be synonymous with *Pellicularia filamentosa* (Pat.) Rogers. The fungus under study, however, produced large sclerotia similar to those of *Rhizoctonia solani* Kühn, also placed under *P. filamentosa*. Such sclerotia are different from the microsclerotia produced by *C. microsclerotia*. On the other hand *R. solani* is usually restricted to the subterranean parts of plants, whereas the fungus on peanuts and mung beans is mostly aerial. Unlike *R. solani*, this fungus produces basidiospores even during August when warm weather prevails. No control measures of this disease are as yet known, except the removal and burning of crop residues.

Outbreaks and New Records

Israel

Plant Protection Division
Ministry of Agriculture, Jaffa

THE following notes cover the incidence of major plant pests and diseases during the period from May to August 1953. A number of insect pests were unusually abundant, whereas many others, such as Mediterranean fruit fly, codling moth, grape berry moth, and mole crickets, which are not included in the present notes, occurred only in normal populations.

Subtropical and Other Fruit Trees

Bostrychid beetle. *Apate monacha* F. appeared this season in great numbers, boring into trunks and twigs of pomegranates, guavas, citrus and other subtropical fruit trees and ornamentals. This pest has been increasing from year to year and may eventually become a serious problem. Until recently it was believed that this beetle attacked only those trees weakened through lack of irrigation or care. Lately, however, it was observed that vigorous trees were also being attacked. So far no chemical method of control is available and sanitary methods are resorted to, i.e., cutting and burning of infested twigs, destruction of neighboring wild hosts, etc. Ferreting out the adult beetles with a wire from individual holes is also very important.

Citrus pests. Citrus rust mite, *Phyllocoptruta oleivorus* (Ashm.), was active in plantations on the coastal plain from May to July. Its population is still on the increase. Sulphur treatments, which are being applied regularly, prove quite satisfactory.

A red mite, *Brevipalpus australis* (Tucker), was found in the coastal citrus nurseries and plantations. This mite was first found in 1946 but was not recorded until this year.

Full scale campaigns against citrus black scale, *Chrysomphalus aonidum* L., are now in progress. Orchards covering thousands of hectares are being sprayed with summer oil. Smaller areas are also being treated against the red scale, *Aonidiella aurantii* (Mask.), and the Florida wax scale, *Ceroplastes floridensis* (Comst.).

Pests of other subtropical fruits. Fig trees were heavily attacked from May to July by the fig maggot, *Louchaca aristella* (Becker), resulting in about 70 to 80 percent fruit drop.

Avocado and mango trees were very severely infested in some localities by the mealy bug, *Pseudococcus adonidum* L. One spray with 25 percent wettable powder of malathon at 0.4 percent gave very satisfactory results in checking this pest.

Pests of stone fruits. During this season stone fruits suffered from unusually severe attacks by several insects. The Buprestid beetle, *Capnodis tenebrionis* L., appeared far more numerous than in previous years. In many plantations it was necessary to spray repeatedly with lead arsenate or sodium fluoaluminate (Cryocide) to eradicate this leaf–eating beetle.

The saw fly, *Cimbex quadrimaculata* (Mull.), a pest usually prevalent in the mountainous zones, seems also to have appeared for the first time in very large numbers in the coastal area. Considerable damage was caused to young almond and plum trees by the leaf–feeding larvae. Spraying with BHC insecticides or sodium fluoaluminate was effective in killing the larvae, but usually the attack developed suddenly and damage was caused before control measures could be undertaken.

The mealy plum aphid, *Hyalopterus pruni* (Geoffroy), heavily attacked almonds in the northern part of Israel. This aphid is found throughout the country but seldom appears in sufficient numbers to cause damage.

Diseases of stone fruits and grapevine. Apple fruit was heavily damaged by *Gloeosporium* sp. during June and July in the central part of the country, in orchards which received overhead irrigation. Powdery mildew (*Podosphaera leucotricha*) was common on apple leaves, and scab caused by *Fusicladium dendriticum* was found occasionally on local apple varieties. Die-back of branches, caused by *Macrophoma* sp., was observed in various orchards, but caused no serious damage.

Plum leaves were affected by shot hole in many parts of the country. The causal agent could not be established but seems to be physiological.

Downy mildew (*Plasmopara viticola*) was severe in the vineyards on the coastal plain, and powdery mildew (*Uncinula necator*) was also prevalent.

Vegetables

False wireworms. Unusually large populations of false wireworms (Tenebrionidae) appeared after the heavy irregular rains in March and April, causing considerable damage to cucurbits, sunflowers, tomatoes, maize, sorghum and other young crops. Soil treatment with aldrin at the rate of 200 gm. active ingredient per dunam (= 0.1 hectare) was effective for killing both adults and larvae.

Cotton worm. Toward the end of June the Egyptian cotton worm, *Prodenia litura* F., heavily attacked peanuts, tomatoes, maize and many other crops. The nonedible plants infested by larvae were treated with dieldrin with satisfactory results, while poison baits had to be repeatedly used in fields of edible crops to obtain some measure of control.

Chrysomelid beetle on cucurbits. Cucurbits were mainly attacked by the Chrysomelid beetle, *Rhaphidopalpa foveicollis* (Lucas). The adults destroyed the leaves and the larvae caused severe injuries to roots. In some localities the damage was more severe than usual. Sodium fluoaluminate or nicotine failed to give satisfactory control of the beetle. The synthetic polychlorinated insecticides were not used for fear of injuring the plants.

Onion thrips on solanaceous plants. Tomatoes and potatoes suffered from an excessively heavy attack of onion thrips, *Thrips tabaci* Lind., which, however, were successfully controlled by chlordane and dieldrin.

Potato diseases. Late blight (*Phytophthora infestans*) caused heavy losses of potatoes in May, especially in fields which had not received prophylactic treatments. The variety Up-to-Date, when sown late, suffered badly from an internal necrosis due to heat injury. A bacterial ring rot was noted at one settlement in the north. The disease is being investigated and all potato tubers from this settlement have been discarded as seed.

Tomato diseases. Leaf diseases, caused by *Alternaria* sp., *Septoria* sp. and *Phytophthora infestans* were prevalent in May, but declined in July and August. In June, powdery mildew (*Oidiopsis* sp.) appeared and blossom end rot caused extensive losses of fruits. The most important tomato disease, however, is still the wilt caused by *Fusarium* sp. which was destructive in June and July.

Strawberry diseases. *Ramularia* sp. causing leafspots was reported throughout the country. Root diseases due to *Rhizoctonia solani* and *Fusarium* caused serious losses, especially in fields planted in autumn. The introduced American varieties seem to be especially susceptible.

Watermelon wilt and pest. A wilt disease, caused by *Fusarium* sp., caused extensive damage in watermelon plantings. This disease was especially severe in irrigated fields and it was thought that faulty crop rotation contributed to some extent to this severe outbreak. The dying of sideshoots without previous root infection was noted and is believed to be caused also by *Fusarium*.

Watermelon fruits were heavily infested by a small Curculionid beetle, *Acythopeus granulipenis* (Journ.), whose maggots devoured the inside of the fruit.

Field crops

Cereal pests. The durra stem borer, *Sesamia cretica* Lederer, appeared during May, June and July in unusually large numbers causing considerable damage to maize, durra and sorghum. In some places it was necessary to spray the infested field crops with a stomach poison.

The Scarabeid beetle, *Anisoplia leucaspis* Lap., was very abundant during the

spring in wheat fields, feeding upon the roots.

Pests of other crops. In experimental plots of cotton, a very heavy attack of onion thrips, *Thrips tabaci*, was observed. Apparently the thrips migrated to the cotton plots from the neighboring bindweed (*Convolvulus arvensis*).

In some localities bales of hay were infested by Tenebrionid beetles of the genus *Mesomorphus*. The beetles fed on the young green parts of the hay causing considerable loss.

Sclerotium rot on sugar beet. In sugar beet fields where lifting was delayed, *Sclerotium rolfsii* caused severe losses, in some instances amounting to 50 or 60 percent of the crop. This disease was reported as far south as Hatzor and in the north as far as the Emek, with a further outbreak in upper Galilee. Damage was heaviest in the Emek Hefer and in western Galilee.

Sunflower rust. *Puccinia helianthi* infected sunflowers throughout the country. It was first noted in mid–July and the losses caused were significant.

Diseases of peanuts. Peanuts grown on light soils in the coastal region were damaged considerably during May by a species of *Sclerotium* bearing small sclerotia. In June and July, this crop throughout the country suffered from heat burn near the root collar and damage at times was severe.

NEWS AND NOTES

United Kingdom Ratifies International Plant Protection Convention

The Government of the United Kingdom, whose representative signed the International Plant Protection Convention on 6 December 1951, deposited the instrument of ratification with the Director-General of FAO on 7 September 1953. This brings the number of countries contracting to the Convention to eighteen, namely: Australia, Austria, Belgium, Cambodia, Canada, Ceylon, Chile, Denmark, Dominican Republic, Egypt, El Salvador, India, Indonesia, Japan, New Zealand, Spain, Sweden, and the United Kingdom.

Desert Locust Control Meeting

In association with the Government of Syria, FAO is convening a meeting on Desert Locust control at Damascus, commencing 5 November 1953. Invitations have been extended to the governments of 23 countries liable to be affected by swarms which may escape from uncontrolled breeding in the Arabian Peninsula. The purpose of the meeting is to determine the extent to which governments and agencies may contribute to an international campaign in Arabia during the winter-spring of 1953–54 in support of the anti-locust operations of the local governments.

VIIIth International Congress of Botany

The Eighth International Congress of Botany will be held in Paris, 2–14 July 1954. There will be twenty-seven sections, covering all branches of botany. The sections most concerned with plant protection will be those on phytopathology, mycology, bacteriology, and antibiotics in plant biology.

In the section on phytopathology, symposia will be organized on the following subjects:

1. Types of rots in tropical timbers especially produced by Polyporaceae.
2. Competition of fungi in diseases of cultivated plants.
3. Incubation in mycosis.
4. Bacteriosis of Solanaceae.
5. Bacteriosis of tropical fruits.
6. Morphology of virus.
7. Interferences between viruses.

Excursions of botanical interest will be arranged before and after the Congress to visit various parts of France and overseas territories.

Enquiries and correspondence concerning the Congress should be addressed to the Secrétariat Général, 292, rue Saint-Martin, Paris IIIe, France.

International Chestnut Commission

The establishment of the International Chestnut Commission was authorised by the FAO Conference in 1951, to study effective methods for the control of the chestnut blight, to develop resistant hybrids, and to co-ordinate research into the silviculture and utilization of the timber and fruit of *Castanea*. During the first session of the Commission, held in Italy and Switzerland in 1951, plans were laid to make this Commission a permanent coordinating center for chestnut investigations.

The second session of the Commission was held in Spain and Portugal, 18–30 June 1953, attended by delegates of Italy, France, Portugal, Spain and the United States. The International Union of Institutes for Forestry Research was also represented. In addition to regular meetings, a study tour was organized to visit the chestnut growing regions in Spain and Portugal.

During the meetings, measures for controlling the chestnut blight were fully reviewed. *Castanea sativa* is known to be resistant to this disease in several countries and in Italy new growth developed from infected stumps was often free from infection.

In view of the fact that the menace of the chestnut blight and the risk of its spreading remain grave in a number of countries, the Commission recommended that intensive studies be continued with special reference to developing and propagating resistant types and hybrids, and that countries take quarantine measures to retard the spread of the disease.

Roma - Tip. del Senato del dott. Giovanni Bardi

CEREAL BREEDING PROCEDURES

This FAO Development Paper covers the whole field from the hybridization of the parent plants until a new variety is in commercial production. Methods of growing hybrid populations, systems of testing and recording of results, variety purification and increase of pure seed, as well as the analysis of data, are treated in detail. Various types of nurseries are described for the breeding of varieties resistant to plant diseases and insect pests, and tolerant to certain climatic factors such as frost.

Special features of the publication are the sixteen appendices which graphically illustrate planting plans, plot arrangements, the statistical progress of a cross, variety purification and other features of a cereal breeding program. The complexity involved in modern plant breeding methods and the consequent necessity of systematizing the procedures are clearly and impressively indicated. 122 pages, $1.25; 6/3.

LEGUMES IN AGRICULTURE

This unique collection of information on legumes, edited by R. O. Whyte, G. Nilsson-Leissner and H. C. Trumble, required the collaboration of specialists in every Member Country of FAO. No fewer than 111 contributors are acknowledged, and contributions from many more are mentioned in the text.

Nowhere else is such information available in one volume and, by pointing to the limitations in the data on economic botany, ecology and the biotic relationships of legumes it is hoped to encourage further research and experiment particularly in tropical and sub-tropical areas. An appendix tabulates the species, indicating plant characteristics, climatic adaptation, soil adaptation, utilization, number of seeds per pound and seeding rates in pounds per acre. 368 pp., many illustrations, $ 3.00; 15s.

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